PATENT APPLICATION BASED ON:

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METHOD FOR SAVING POWER IN AN ORGANIC ELECTROLUMINESCENT DISPLAY

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METHOD FOR SAVING POWER IN AN ORGANIC ELECTROLUMINESCENT DISPLAY

FIELD OF THE INVENTION

This invention relates generally to organic electroluminescent displays, and more particularly, to a method for reducing the power consumed by an organic electroluminescent display panel.

BACKGROUND OF THE INVENTION

Full color organic electroluminescent flat panel displays such as organic light emitting diodes (OLEDs) consist of two dimensional arrays of discrete light emitting elements. A common configuration for such a device includes columns of alternating red, green and blue emitting elements. Another configuration includes closely placed triplets of light emitting elements, each triplet consisting of one each of a red, green and blue light emitting diode. Color organic electroluminescent flat panel displays are presently planned for wide use in battery powered portable electronic devices such as personal computers, digital assistants and cellular telephones. A common problem with such apparatus is the limited time of operation before the battery must be replaced or recharged. One approach to saving power is to automatically put the device into a minimum power usage sleep mode if there has been no active use of the device for a predetermined time. This approach however is not very useful if the device is continually in use. There is a need therefore for an improved method of conserving power

SUMMARY OF THE INVENTION

The need is met according to the present invention by providing a method of saving power in a color organic electroluminescent display of the type having color emitting elements with different light emitting efficiencies, that includes the steps of: determining the color of the elements having the highest efficiency; converting a color digital image to be displayed on the display to a

monochrome image; and displaying the monochrome image using the determined color elements.

ADVANTAGES

The present invention has the advantage that power can be saved while continuing to use the display device.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematic diagram illustrating the normal full color operation of an organic electroluminescent display;

Fig. 2 is a schematic diagram illustrating the power saving mode of operation of an organic electroluminescent display according to the present invention; and

Fig. 3 is a schematic block diagram of a battery powered cell phone having an organic electroluminescent display capable of being operated in a power saving mode according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

The present invention is directed to a method of conserving power in a portable OLED device. OLEDs create a color image by emitting colored light at each individual pixel site. The OLED has a useful property in that the only light emitting elements that consume power are the light emitting elements that are turned on. In other words, the power consumed by the OLED device can be reduced by turning individual light emitting elements off. It is known that the various colors of OLED materials do not create light with the same efficiencies. The present invention takes advantage of this property to provide a method for displaying an image using the most efficient light emitting channel of the OLED device. This display mode saves power by turning off the less efficient color channels, and using the most efficient channel for displaying the image.

A typical active matrix OLED display has red, green and blue light emitting elements. When all of the light emitting elements are off, the display

consumes a minimum of power, and the display appears black. When all of the light emitting elements are turned on, the red, green and blue light mixes, and the display appears white. The materials used to produce the different colors of light do not have the same light emitting efficiencies. Some of the materials will produce more light output than others, for a given amount of input current. For example, the green light emitting materials are often the most efficient, and may be as much as four or five times as efficient as the blue material, which is the least efficient.

Fig. 1 shows the normal mode of operation of a full color OLED display **10**, the data from each color channel (**12, 14, 16**) is used to drive the corresponding colored light emitting elements (**18, 20, 22**) in the OLED display **10**.

It is known that the luminance content of a colored image can be represented by adding together a weighted portion of each of the intensities of the red, green and blue components of the image. For example in one known technique for converting a color image to a monochrome image, the relative weighted amounts of red, green and blue used to produce a gray scale luminance value are:

$$\text{Luminance} = (5/16) * \text{red} + (9/16) * \text{green} + (2/16) * \text{blue} \qquad (1)$$

Fig. 2 shows how the image data can be processed by multiplying the data in each channel by a fraction (**24, 26, and 28**) and summing (**30**) the processed channels to produce a weighted luminance sum, and that sum is used to drive one of the channels (e.g. the green channel) on the OLED display.

Referring to Fig. 3, in certain portable applications, such as a cellular telephone **32**, it may be acceptable to switch from a full power, full color mode to a low power monochrome mode. The cell phone **32** includes a full color OLED display **10**. A transceiver **34** is connected to an antenna **36** and a controller **38**. The cell phone is operated by a keypad **40** connected to the controller. The controller sends signals to a digital image processor **42** that in turn sends processed digital image signals to a display driver **44** that drives the display. A

power supply, such as a battery pack **46** supplies power to the components of the cell phone, including the display **10**. A power supply monitor **48** is connected to the power supply **46** and signals the controller as to state of charge of the batteries in the power supply.

When the battery **46** is low on stored power, it may be more important to use the remaining power to receive and transmit, than to display full color on the OLED display **10**. This low power monochrome mode can be achieved by converting the full color RGB color image to a luminance only gray scale image as described above in the digital image processor **42**, and displaying that monochrome image on the green light emitting elements (only) of the OLED display **10**. The inefficient red and blue light emitting elements would all be turned off, and the image would be displayed on the efficient green light emitting elements. The low power mode of operation can be selected manually, for example by a code that is input into the keypad **40**, or automatically by the controller in response to the signal provided by the power supply monitor **48**.

The present invention is also useful in devices such as laptop computers and personal digital assistants, for example, by providing the option to switch to a power saving mode when doing tasks such as word processing that don't necessarily require full color.

The invention has been described in detail with particular reference to certain preferred embodiments thereof, but it will be understood that variations and modifications can be effected within the spirit and scope of the invention.

PARTS LIST

10	OLED display
12	red color channel
14	green color channel
16	blue color channel
18	red pixel element
20	green pixel element
22	blue pixel element
24	multiply red channel data
26	multiply green channel data
28	multiply blue channel data
30	sum multiplied channel data
32	cell phone
34	transceiver
36	antenna
38	controller
40	keypad
42	image processor
44	display driver
46	battery pack
48	power supply monitor